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Coded Sequences for Low Power Pulse Echo Systems

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There are many ultrasound applications where power is limited and as a result signals with low signal to noise ratio (SNR) are produced, electromagnetic-acoustic transducers (EMATs) and air coupled transducers being some examples. In those cases the SNR can be increased by averaging or pulse compression techniques. However, averaging is often lengthy because of the long wait periods required for the signals to die out in-between subsequent transmissions. Pulse compression, such as coded sequences, permits a more rapid injection of energy into the medium. Longer sequences mean a higher SNR can be realised; however, the length of the sequence is usually limited by the distance between the source and the closest reflector. This paper presents a new way of coding the excitation using built-in reception gaps so that continuous transmission and reception of long coded sequences is possible. This results in a substantial SNR increase for the same measurement duration or equivalently a shorter duration for the same SNR. The theory behind the proposed coded excitation is presented as well as experimental validation, where an EMAT is excited using the proposed coded excitation with low power, just 4.5V, obtaining a clear signal in quasi-real time. Commercial EMAT systems require a 1200V excitation for similar performance.

Keywords: Pulse compression, Signal processing, Coded excitation, EMATs, Ultrasound
PACS codes:

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